SCIENCE

NEW SERIES
VOL. LII, No. 1353

FRIDAY, DECEMBER 3, 1920

SINGLE COPIES, 15 CTS.
ANNUAL SUBSCRIPTION, $6.00

SCIENCE

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SOME FEATURES OF THE CHICAGO MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND OF THE ASSOCIATED SOCIETIES, DECEMBER 27, 1920, TO JANUARY 1, 1921

THE Chicago meeting will be the seventy-third meeting of the association. It will be one of the larger and more comprehensive meetings, which are scheduled to be held every fourth year. It promises to be a greater meeting than any earlier one. Every American interested in science or education should attend if possible and should do all in his power to insure the success of the meeting for every branch of scientific and educational work.

Dr. L. O. Howard, Chief of the Bureau of Entomology, of the United States Department of Agriculture, is president-elect and will preside at the Chicago meeting. He has been permanent secretary of the association for twenty-two years, during which the membership of the organization has increased from 1,729 to nearly 12,000. The meetings held during his secretaryship have been increasingly successful and influential.

The address of the retiring president, to be given at the opening general session on the evening of December 27, will be by Dr. Simon Flexner, Director of the Rockefeller Institute for Medical Research.

There will be two other general sessions at the Chicago meeting planned to be of interest not only to all scientific workers and all members of the association but also to the general public. One of these general-interest sessions will be devoted to an illustrated lecture on High-Power Fluorescence and Phosphorescence, by Professor Robert W. Wood, of the physics department of the Johns Hopkins University. The other of these sessions will

be devoted to an illustrated lecture on The Volcanic Region of Katmai, Alaska, by Dr. Robert E. Griggs, of the Katmai Expeditions, National Geographic Society.

Thirty-seven associated societies, many of which are affiliated with the association, will meet with it at Chicago, and their sessions will generally be open to members of the association and the public. The retiring presidents of many of these societies will read presidential addresses. Also, each of the sections of the association, representing different fields of science, will hold its annual session, and the retiring vice-presidents for the sections will each present an address on some broad aspect of his own field. Also, many invitation papers will be read before the sections.

The geographical location of Chicago assures a large attendance and an exceptionally good representation of all branches of scientific endeavor. There have been two meetings of the American Association held at Chicago, one in August, 1868 (with an attendance of 259 and a total membership of 686), and the other at the end of 1907 (with an attendance of 725 and a total membership of 5,114).

For the advancement of science, for the progress of real education, and for the increase of knowledge and of the appreciation of knowledge—which is wisdom—among the people of America, it is especially desirable that this Chicago meeting should be well attended. This meeting will be the first of the larger four-year meetings since the close of the recent war and it will be the most centrally located of the four-year meetings for the next twelve years.[1] The war resulted in an increased appreciation of scientific and educational endeavor and it is of prime importance for the immediate future of American civilization that public interest in the work of the association be encouraged in all possible ways and with the least possible delay. A large and enthusiastic meeting of the association and of the societies associated with it will aid much in this direction, especially at the present time and at such a favorable location as Chicago.

It is therefore hoped that each member of the association and of the associated societies will make special effort to be present at Chicago, considering the matter not only from the ordinary personal standpoint but also with respect to its broader aspects that bear upon the most important features of the public welfare. To the individual, the question as to whether or not he will decide to attend the Chicago meeting is not only one regarding the assured benefit he will personally receive by attending; it also involves even the more important question of how much his presence would aid in making the meeting a success and in thus furthering the growth of well-founded civilization.

The local committee for the Chicago meeting has arranged for the association headquarters to be at the Congress Hotel and has cooperated with the secretaries of associated societies planning to meet with the association, so that headquarters hotels have been designated for these societies. Information regarding seventeen Chicago hotels is given in the announcement. The registration room (in the Reynolds Club, the University of Chicago, 57th St. and University Ave.) will be in telephonic connection with the hotels. Information regarding these, and also about other hotels and rooms in the vicinity of the university, may be had at the information desk in the registration room.

The general sessions of the association, and the sessions of the various sections and associated societies, will occur mainly in the buildings of the University of Chicago, under the auspices of which this meeting is to be held. Specific information regarding the meeting-places of the sections and societies will be given in the General program of the meeting, which will be available on the morning of December 27. Guide-signs and placards will be in evidence where needed, and inquiries may be made at the information desk in the registration room. The three general sessions of the association (evenings of

[1] The 1924–25 meeting will occur at Washington and that for 1928–29 will occur at New York; the 1932–33 meeting will be again at Chicago.

December 27, 28 and 29) will be held in Mandel Hall, entrance under the Tower, on 57th St. just west of University Ave.

There will be three general sessions of the association at Chicago, as follows:

1. Monday, December 27, 8 P.M., Mandel Hall, the University of Chicago. Opening addresses, followed by the address of the retiring president of the association, Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research, New York City. Dr. Flexner will speak on "Twenty-five years of bacteriological research. A fragment of medical science." The presentation of Dr. Flexner's address will be followed by a general reception, to which are invited all members and friends of the American Association and of the associated societies, and all persons interested in science and education.

2. Tuesday, December 28, 8:15 P.M., Mandel Hall. Dr. Robert W. Wood, professor of physics in the Johns Hopkins University, will give a lecture, with demonstrations, on "High power phosphorescence and fluorescence." This lecture will involve recent important developments in the physics of light, presented in such a way as to be readily understood by every one. The experimental demonstrations will be especially interesting.

3. Wednesday, December 29, 8:15 P.M., Mandel Hall. Dr. Robert E. Griggs, of the Katmai Expeditions, National Geographical Society, will give an illustrated lecture on "The volcanic region of Katmai, Alaska." The illustrations will be by stereopticon slides and motion pictures and will be of fascinating interest.

The Wild-Flower Preservation Society will hold a reception to visiting scientists on Tuesday, December 28, at 8 P.M., in the Chicago Art Institute (Michigan Avenue near the Van Buren Street station of the Illinois Central Railway). Visitors will have opportunity to inspect an exhibit of flower portraits, special preparations, etc., which will then be installed in the Art Institute. Mrs. Charles L. Hutchinson is president of the society and Mrs. Charles Scribner Eaton is secretary.

The session programs of the associated societies and of the sections of the association (these programs being in the hands of the society and section secretaries) will be announced in the general program of the meeting, which will be available at the registration room (Reynolds Club, University Avenue and 57th Street) at 9 A.M. on Monday, December 27. Members of the association not attending the meeting, who desire to receive copies of the general program, will be supplied from the permanent secretary's Washington office after January 5, 1921 (as long as copies are available), if they make this request in a letter to the permanent secretary. The session programs, together with abstracts of papers, will be published in SCIENCE, the official publication of the association, during the early part of the new year.

Many joint meetings, dinners, smokers, etc., will be held at Chicago during the meeting, by the several associated societies and the sections of the association. These will be announced in the general program.

One of the important features of the association meetings has long been the opportunity offered for personal contacts among scientific and educational workers and their friends, but it is frequently somewhat difficult for one to find out whether a certain person is present or not and where he is staying if present. An attempt will be made at the Chicago meeting to remove the difficulty just mentioned, by maintaining a continuously corrected directory of all registrants. This directory will be conveniently placed in the registration room and may be readily consulted at any time. It will consist of a series of slips posted in a suitable place, arranged in a single alphabet by surnames. Each slip will show the name of the registrant, his home address and the name of the hotel, etc., where he is stopping for the meeting. Only a few minutes will elapse between the presentation of the registration card at the desk and the appearance of the corresponding slip in the visible directory. It is hoped that this arrangement will prove a source of satisfaction to those in attendance.

By a statement in the By-Laws of the association (Art. X., Sec. 1), "only members who have paid their dues shall enjoy the privileges of the meetings." The three general sessions will be the only occasions for any restriction of admission at the Chicago meeting. Members in good standing and associates for the meeting will enjoy all the privileges, including the general sessions. As set forth in the preceding section of this announcement, registered members and associates are to have the privilege of introducing guests for the general sessions. Members of associated societies who are not members or associates of the association are guests of the association for the three general sessions, but they do not have the privilege of introducing guests.

Students actually in attendance at the University of Chicago are to be guests of the association, in the same way as are members of associated societies. Others may receive the privilege of the general sessions by applying in the registration room, but it is hoped that the cooperative nature of the association will lead most persons of this group to become either members or associates. It is to be remembered that the work of the association requires funds and that the only available source of funds for this work is the dues paid by members and associates. The association does not wish to restrict the benefits of its meetings, but it must emphasize the fact that these are possible only through the loyal cooperative support of those who are interested in scientific advance and in the spread of knowledge.

Delegates to the Chicago meeting from scientific and educational institutions should promptly register as such. They will receive all the privileges of the meeting, as in the case of registered members and associates, except that of voting.

No special program of entertainment for visiting women is planned for the Chicago meeting. The local committee announces, however, that Ida Noyes Hall will be open to visiting women throughout the meeting, including the use of the dining and club facilities of this hall, which is perhaps the finest club for women that has ever been built. Visiting women will wish to inspect Ida Noyes Hall and its various arrangements. The building cost nearly half a million dollars. It will serve as a meeting-place and resting place for women during the meeting, better than has ever been enjoyed at any previous meeting of the association.

Dining-room service will be maintained throughout the meeting, at the University of Chicago Commons and at Ida Noyes Hall.

Persons attending the Chicago meeting may have mail, etc., addressed to them in the care of the American Association for the Advancement of Science, Registration Office, Reynolds Club, the University of Chicago, Chicago, Ill. They should call at the registration room daily, to inspect the personal bulletin, which will be conveniently located for quick inspection. If a person's name appears on this bulletin, it means that he should enquire at the proper desk for mail, etc. At the close of the meeting, or upon leaving, those in attendance are urged to leave a forwarding address for mail, etc. If this is not done, letters, etc., that are not delivered must be taken to Washington and resent from there, to the addresses shown in the files of the permanent secretary's office.

It has been impossible to secure any reduction in railroad rates for those attending the Chicago meeting. This matter is receiving serious attention and it is hoped that arrangements may be made by which reduced rates may be granted to the association for future years.

Members of the association and of associated societies who present papers at the Chicago meeting should come provided with abstracts of their papers, clearly and popularly presented, for the use of the Chicago press. All such material is to be given out through the publicity office of the local committee which will be in charge of Mr. Gilbert A. Bliss, of the local committee. It is hoped that all those in attendance will take an interest in this aspect of the meeting and that they will cooperate with Mr. Bliss, to the end that a suitable publicity may be obtained. This is a very

important feature in the work for which the association exists.

Those in attendance at the meeting may obtain information of all sorts by applying at the information desk in the registration room. Before the meeting, information may be obtained from the secretaries of the sections or of the associated societies (regarding programs, etc.), from the chairman of the local committee, Professor J. Paul Goode, of the University of Chicago regarding local arrangements, or from the permanent secretary's office in Washington regarding general association affairs.

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A MORE NEARLY RATIONAL SYSTEM OF UNITS

SYSTEMS of units for physical magnitudes are designed to permit arithmetical calculations on the basis of known physical laws, and the test of the efficiency of any system is the extent to which it facilitates such computations. There are two ways, in particular, in which this can be accomplished: first, by relating the units of any one magnitude in a manner consistent with the system of arithmetic in use; with a decimal arithmetic this requires that the ratio of such units be a power of 10, *e. g.*, the erg and the joule; second, by so relating the units of different "dimensions" as to prevent the appearance of arbitrary and irrational factors in the equations expressing the fundamental laws of natural science, *e. g.*, the "gas law" should take the form "pressure = concentration × temperature" ($P = CT$) rather than "pressure is proportional to concentration × temperature" ($P = CRT$). The failure of the "English" system of weights and measures to meet these requirements is a matter of common knowledge, but it seems worth while to point out how little superior in these respects is the present "metric" system.

The common basis of both these systems of physical and chemical units comprises: (1) the decimal arithmetic, (2) the mean solar second and (3) the table of atomic weights based on $O \equiv 16$. It is not intended here to discuss these fundamentals, beyond pointing out that no one of them is entirely rational, and if they are retained it will be only because the difficulties in the way of superseding them outweigh the advantages of a change. The purpose of this paper is an inquiry whether on this common foundation there can be construed a system of units superior to either of the two now in common use.

1. Two systems of arithmetic with a base other than 10 are suggested by the methods of division of units in the case of "English" weights and measures (*a*) the twelve-system, illustrated by the dozen and gross and by the divisions of the foot and the pound Troy; (*b*) the two-system, illustrated by the divisions of the inch, the gallon and the pound avoirdupois. Both modes of division are used in coinage, though not at all consistently, (*a*) in the case of the shilling of twelve pence, (*b*) in the penny of four farthings and the distinctly non-decimal division of the dollar into quarters (and even into "bits" of 12½ cents). In a recent eulogy of the twelve-system (SCIENCE, N. S., 50, 239–242 (1919)), Dr. William Benjamin Smith says:

"This best of numerical systems is not the ten-system (which is recommended only by the fact that man has ten fingers and ten toes!) but the twelve-system, whose virtues are imbedded in the nature of number itself."

2. The humor of basing a decimal system of weights and measures on a unit of time obtained by dividing the mean solar day successively into 24, 60 and 60 parts, hardly needs emphasis. The mean solar day is the average interval between the passage of the sun across the meridian for any locality. The maximum difference between mean solar time and true solar time is 16 minutes (about November 1 of each year).

3. The change from the $H_{III} 1$ system of atomic weights to the present $O \equiv 16$ was made both because of the uncertainty of the H:O ratio and because the oxygen standard made more of the atomic weights approximate whole numbers. Re-

[1] Forty-first Contribution from the Color Laboratory of the Bureau of Chemistry, Washington, D. C.

sults lately obtained on the atomic weights of the *isotopes* of lead and of neon indicate that one sixteenth of the atomic weight of oxygen is very near indeed to the unit mass of the Prout hypothesis, but it is highly improbable that it should be identical with it. (It would require that oxygen consist of one isotype only—or a still less probable balancing of heavy and light isotopes.)

The most flagrant case of irrationally related metric units is that of electrical quantity, for which four units, no two of which are commensurable, are in actual use. These four are (1) the electrochemical equivalent of electricity, or Faraday, (2) the coulomb, which is one tenth of the centimeter-gram-second electromagnetic unit, (3) the centimeter-gram-second electrostatic unit and (4) the "Heaviside" electrostatic unit, differing from the foregoing by the factor $1/\sqrt{4\pi}$, and used by Lorentz and others in electron theory calculations in order to give a simple form to the fundamental equations for the electromagnetic field. The ratio of the electromagnetic to the electrostatic unit is numerically the same as the velocity of light, hence a reconciliation is possible only in a system which makes the numerical velocity of light a power of 10. A unit of the Heaviside type is quite satisfactory for practical use, hence the adoption of such a unit would obviate the necessity of having one unit for theoretical and another for practical work. Finally, by a suitable selection of a unit of mass the electromagnetic and electrochemical units can be brought into harmony. (It should be noted that this involves giving up the use of water as a standard of density.) To summarize: it is possible—by making the numerical value of the velocity of light a power of 10, by suitably choosing the unit of mass, and by using the Heaviside definition of unit charge—to derive a single unit of electrical quantity suitable for all purposes.

Heat and temperature units are to be derived by purely dynamic definitions, without regard to the properties of the substance, water. Unit temperature is the temperature at which unit concentration of a "perfect gas" exerts unit pressure on the walls of its container; while the difference between the heat capacities of a mol of "perfect gas" at constant pressure and at constant volume is the unit of heat capacity and of entropy.

In Table I. are given the numerical factors which, in various combinations, are involved in conversion between the proposed units and those of the centimeter-gram-second system.

TABLE I

Symbol	Definition	Numerical Value[2]
4π	Ratio of area of sphere to square of radius	12,5664
10^9	Numerical value assigned in proposed system to the velocity of light and to the electrochemical equivalent[3]	12.5664
c	Velocity of light in c.g.s. units	29,986,000,000. cm. per sec.
E	Electrochemical equivalent[3] in c.g.s. units	9,647.2 units per equivalent
R	Gas constant in c.g.s. units	83,150,000. ergs per mol per °C.
J	Value of the mean calorie in c.g.s. units	41,850,000. ergs per calorie

Tables II., III. and IV. give the ratios of the proposed units to those of the metric system—both algebraically in terms of the factors terms listed in Table I., and numerically. Numerical values are given only when the metric unit compared has a name in common use.

The names for multiples and submultiples of the fundamental units would be formed with the prefixes now in use in the metric system, *e. g.*, the kilo-unit of electric current and the mega-units of pressure and of temperature would probably be used more than the fundamental units; but, aside from the preference of one multiple or submultiple to another, the

[2] The values for the last four are taken from Kaye and Laby's tables.

[3] The quantity of electricity required to deposit electrolytically one equivalent of metal. E, the electricity in c.g.s. electromagnetic units per equivalent, is used instead of F, the number of coulombs per equivalent, to avoid mixing engineering and c.g.s. units.

TABLE II

Geometric, Kinematic and Mechanical

Unit of		In Terms of C.G.S. Unit		In Terms of Engineering Unit
Distance	$\frac{c}{10^9}$	29.986 cm.	$\frac{c}{10^{11}}$	0.29986 m.
Area	$\frac{c^2}{10^{18}}$	898.92 sq. cm.	$\frac{c^2}{10^{22}}$	0.089892 sq. m.
Volume	$\frac{c^3}{10^{27}}$	26951. c.c.	$\frac{c^3}{10^{33}}$	0.026951 cu. m.
Time	1	1 sec.	1	1 sec.
Velocity	$\frac{c}{10^9}$	29.986 cm. per sec.	$\frac{c}{10^{11}}$	0.29986 m. per sec.
Acceleration	$\frac{c}{10^9}$	29.986 cm. per sec.^{2}	$\frac{c}{10^{11}}$	0.29986 m. per sec.^{2}
Mass	$\frac{c}{4\pi E^2}$	25.636 g.	$\frac{c}{4\pi 10^3 E^2}$	0.025636 kg.
Concentration	$\frac{10^{30}}{4\pi c^2 E^2}$	0.9512 molal		
	$\frac{10^{27}}{4\pi c^2 E^2}$	0.0009512 g. per c.c.		
Momentum	$\frac{c^2}{4\pi 10^9 E^2}$	768.62 g. cm. per sec.	$\frac{c^2}{4\pi 10^{14} E^2}$	0.0076862 kg. m. per sec.
Force	$\frac{c^2}{4\pi 10^9 E^2}$	768.62 dyne	$\frac{c^2}{4\pi 10^{14} E^2}$	0.0076862 j. per m.
Pressure	$\frac{10^9}{4\pi E^2}$	0.85504 dyne per cm.^{2} (bar)	$\frac{10^8}{4\pi E^2}$	0.085504 j. per m.^{3}
Energy	$\frac{c^3}{4\pi 10^{18} E^2}$	23045. erg.	$\frac{c^3}{4\pi 10^{25} E^2}$	0.0023045 joule

units in engineering and scientific work would be identical.

The advantages to be gained are indicated by the following statement of some of the points of difference from both the English and the metric system. In the proposed system:

The fundamental unit of capacity (liquid measure) is the cube of the unit of length.

Astronomic units of distance now in use, "light second," "light hour," etc., are commensurable with the units proposed, the first being one *billion* times the fundamental unit of length.

Under "standard conditions" one mol of "perfect gas" occupies unit volume.

The difference between the specific heats of a "perfect gas" at constant pressure and at constant volume is 1.

Unit current in electrolysis deposits per second one *billionth* of an equivalent of metal.

The electrostatic capacity of an air condenser and the permeance of a magnetic air gap (or a magnetic circuit in air) are each one *billionth* of their respective "shape factors."[4]

The electric flux from a charge is equal to the charge, and the magnetic flux from a magnetic pole is equal to the pole strength.

The magnetomotive force, per turn, of a coil is equal to the current flowing through it.

The electromotive force, per turn, generated in a coil is equal to the rate of change of the flux within it.

The energy of an electric, or magnetic, field is equal to one half the product of the flux and, respectively, the electromotive or magnetomotive force.

[4] "Flow of Heat through Furnace Walls; the Shape Factor," Irving Langmuir, E. Q. Adams and G. S. Meikle, *Trans. Amer. Electrochem. Soc.*, 24, 53 (1914).

TABLE III

Electric and Magnetic

Unit of	In Terms of C.G.S. Unit		In Terms of Engineering Unit	
	Electrostatic	Electromagnetic		
Charge	$\frac{c^2}{4\pi 10^9 E}$	$\frac{c}{4\pi 10^9 E}$	$\frac{c}{4\pi 10^8 E}$	0.0024732 coulomb
Current	$\frac{c^2}{4\pi 10^9 E}$	$\frac{c}{4\pi 10^9 E}$	$\frac{c}{4\pi 10^8 E}$	0.0024732 ampere
Potential	$\frac{c}{10^9 E}$	$\frac{c^2}{10^9 E}$	$\frac{c^2}{10^{17} E}$	0.9318 volt
Capacity	$\frac{c}{4\pi}$	$\frac{1}{4\pi c}$	$\frac{10^9}{4\pi c}$	0.0026542 farad
Resistance	$\frac{4\pi}{c}$	$4\pi c$	$\frac{4\pi c}{10^9}$	376.74 ohms
Energy	$\frac{c^3}{4\pi 10^{18} E^2}$	$\frac{c^3}{4\pi 10^{18} E^2}$	$\frac{c^3}{4\pi 10^{25} E^2}$	0.0023045 joule
Flux	$\frac{c}{10^9 E}$	$\frac{c^2}{10^9 E} =$		93180000 gauss
Density	$\frac{10^9}{cE}$	$\frac{10^9}{E} =$		103660 maxwell
Magnetomotive force	$\frac{c^2}{10^9 E}$	$\frac{c}{10^9 E} =$		0.0031079 gilbert
Reluctance	c	$\frac{1}{c} =$		0.000000000033353 oersted
Energy	$\frac{c^3}{4\pi 10^{18} E^2}$	$\frac{c^3}{4\pi 10^{18} E^2} =$		23045 erg

TABLE IV

Thermal

Unit of	In Terms of Calorimetric Units		In Terms of C.G.S. Units	
Heat capacity	$\frac{cR}{4\pi E^2 J}$	50.934 calories per g. per ° C.	$\frac{cR}{4\pi E^2}$	2131600000. ergs per g. per ° C.
Entropy	$\frac{cR}{4\pi E^2 J}$	50.934 calories per g. per ° C.	$\frac{cR}{4\pi E^2}$	2131600000. ergs per g. per ° C.
Temperature	$\frac{c^2}{10^{18} R}$	0.000010811 degree	$\frac{c^2}{10^{18} R}$	0.000010811 degree
Energy	$\frac{c^3}{4\pi 10^{18} E^2 J}$	0.00055064 calorie	$\frac{c^3}{4\pi 10^{18} E^2}$	23045. erg

A few examples of the working of the system of units follow. It has been thought best not to attempt to coin names for the proposed units, hence the values will be given without designation unless a multiple or submultiple of the fundamental unit has been used, when the abbreviation of the appropriate Metric prefix will be added (μ, micro-; m, milli-; c, centi-; d, deci-; D, deka; H, hecto-; K, kilo-; M, mega-).

Find the capacity of a vat of length 10, width 5 and depth 4. Answer: $10 \times 5 \times 4 = 200$

Find the volume of a sphere of 1 light second radius. Answer:

$$\tfrac{4}{3}\pi(10^9)^3 = \tfrac{4}{3}\pi \times 10^{27}.$$

Find the molecular weight of a substance, a mass of 15 m of which occupies a volume of 12 m, at a temperature of 30 M and a pressure of 1.2 M. Answer:

$$\frac{15 \times 30}{12 \times 1.2} = 31.25.$$

Find the time required with an electric current of 10 K and a potential of 100 to heat unit mass of helium (atomic weight, 4) through a temperature interval of 10 M, at constant pressure. (The specific heat of a monatomic gas at constant *volume* is 3/2.) Answer:

$$\frac{\frac{1}{4} \times 10^7 \times (\frac{3}{2} + 1)}{10^4 \times 100} = 62.5 \text{ sec.}$$

Find the mass of copper (valence 2, at.wt. 63.57) that would be deposited by a current of 10 K in 1,000 sec. Answer:

$$\frac{63.57 \times 10^4 \times 1{,}000}{2 \times 10^9} = 0.318.$$

Find the capacity of a condenser with 100 sheets of dielectric (of dielectric constant 2) each of unit area and thickness 0.01. Answer:

$$\frac{100 \times 1 \times 2}{10^9 \times 0.01} = 2 \times 10^{-5} = 20\mu.$$

Find the inductance of a coil of 100 turns wound on a closed core of iron of permeability 1,000, of cross section 0.2 × 0.2 and length of magnetic circuit 4. Answer:

$$\frac{100^2 \times 1{,}000 \times .2 \times .2}{10^9 \times 4} = 10^{-4}.$$

Find the magnetic energy of the core when a current of 1 K is passing through the coil. Answer:

$$\tfrac{1}{2} \times (10^3)^2 \times 10^{-4} = 50.$$

In conclusion, it should be noted that the foregoing is primarily a description of a method of deriving a system of units, and that a system of substantially equal convenience could be devised with an other than decimal arithmetic, a different unit of time or another basis of atomic weights.

SUMMARY

1. On the common foundation of the English and metric systems of units there can be constructed a system superior to either.

2. Its bases are (1) the mean solar second, (2) a length of 29.986 cm. and (3) a mass of 25.636 g.

3. Tables of the relation of the various units in this system to the corresponding metric units are given.

4. A single set of units serves for both engineering and scientific purposes.

ELLIOT Q. ADAMS

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PALEONTOLOGY AND PRAGMATISM

Two recent publications of the United States National Museum admirably illustrate a phase of the scientific activities of the government to which I have long thought of calling attention, since they are accomplished without noise or press notices and are of immense value to the people as a whole in addition to their intrinsic scientific worth.

The publications to which I refer are North American Early Tertiary Bryozoa, by Canu and Bassler, constituting Bulletin 106, and Contributions to the Geology and Paleontology of the Canal Zone, by T. Wayland Vaughan and associates, constituting Bulletin 103. More particularly I wish to refer to the work of Canu and Bassler on the Bryozoa, Joseph A. Cushman on the Foraminifera, Marshall A. Howe on the calcareous algæ, and T. Wayland Vaughan on the corals.

These are all groups of organisms whose habits are exceedingly interesting and whose forms are often highly artistic, but none of which furnish food for commercial fishes or humanity, or are objects of trade,[1] or yield any gums, wax, gems, or minerals that might make them seemingly worth while to the man in the street.

The Bryozoa are inconspicuous colonial animals, some of them with a beauty all their own, but seldom appreciated since they require magnification in order to be seen to advantage. Some are usually included in amateur collections of so-called sea weeds, but to the average person a bryozoan is as unknown as a native of Mars. The recently installed sea

[1] The red coral of commerce and its imitations are exceptions, but these are European and not American products and do not affect the force of the statement.

bottom exhibit in colored glass at the American Museum of Natural History will undoubtedly call the attention of a considerable circle to the wonderful habits and esthetic forms of these tiny animals. That the monograph by Canu and Bassler is a splendid contribution to paleozoology goes without saying —the names of the authors are a guarantee of that—what I wish to emphasize is the utilitarian value of such studies.

The Bryozoa belong to a geologically very old phylum, the vast majority secrete a calcareous skeleton, and since they are so plentiful and so tiny they are preserved as fossils in great abundance at very many geological horizons. They are thus admirably adapted to become medals of creation, and highly satisfactory time markers for geologists. They well illustrate the old aphorism of the importance of the insignificant, since while infinitely varied in detail, their specific limits are usually sharp and their range in time is not too great to enable them to be used with great precision in the determination of the age of geological formations and their correlation over wide areas. Their value has long been recognized in the older geological formations of the Paleozoic and Mesozoic, but in this country at least, their usefulness in delimiting the later formations, has hitherto remained unevaluated.

Geologic correlation may seem remote from the affairs of the workaday world and yet upon its successful consummation rests not only the understanding of the local and general relations underground that are the basis of all exploitation of artesian waters, oil, and other mineral resources of the earth, but it is of prime importance in determining the places or origin and the paths of migration of the life of bygone days. The early Tertiary bryozoa of the Atlantic Coastal Plain not only serve to substantiate the evidence derived from other classes of fossils, but may be expected to eventually help determine whether the past floodings of this region were simultaneous with similar events in the Old World and hence caused by changes in sea level or whether these were due to regional changes in the attitude and elevation or depression of the land.

National Museum Bulletin 103 contains eleven different papers upon the geology and paleontology of the Canal Zone and much additional information with regard to the Antilles, especially with respect to the corals. In fact, if the Mollusca could have been included, it would serve as a complete manual of the geology and paleontology of that region.

A knowledge of calcareous algæ, either recent or fossil, is confined to a few specialists. Their fossil remains have never been much used in stratigraphic geology, because, like the bryozoa, diatoms and foraminifera, sufficient intelligence had not been focused upon them to determine their value as indicators of horizons, past events, or past physical conditions. It is only recently that their importance in the formation of magnesium carbonate and the great part they take in the formation of the so-called coral reefs of both the past and the present, has been understood.

The Foraminifera constitute a group of organisms that are exceedingly abundant in existing seas, and useful in a variety of ways in studies of plankton and experimental evolution. They belong to the great and primitive group of the Protozoa, or unicellular animals, and since, unlike so many of their congeners, they early acquired a siliceous or calcereous skeleton they have been preserved in ever increasing abundance in certain marine formations from the Silurian down to the present.

Although they have been utilized to some extent abroad, particularly in the recognition of zones in the nummulitic limestones of the Mediterranean regions, they have attracted but few students in this country, and have been rather generally regarded as lacking in chronologic value. This reputation was largely the result of the specific limits as conceived by English students such as Parker, Jones and Brady, who published large standard works in which single species showed most astonishing ranges of millions of years. Naturally forms that live on unchanged for eons

may safely be ignored in trying to determine the age and succession of the rocks.

It may be doubted, however, if any class of organisms do not have an interesting and important story to tell provided we learn their language. This has proven to be the case with our American foraminifera at the hands of Cushman. Since forams are generally small and abundant when present at all they stand a much better chance of preservation in both compact limestones and coarse sandy marls than do the tests of higher and larger marine organisms. They have been particularly useful in tracing the Tertiary geological zones around the equatorial belt of the world. In Panama, around the borders and on the islands of the Spanish Main, as well as in our own southern coastal plain, the Foraminifera have proven to be often the only, and always among the most satisfactory types of fossils. Widely distributed in the seaways, rapidly mutating into recognizable differentials, they have been one of the keys to our understanding of the history of equatorial America.

They, like the Bryozoa, are generally small enough to be present in well samples where larger forms are not encountered or are largely smashed beyond recognition by the drills. They have lately been shown to be of profound significance in the location of the oil sands by means of a study of well cuttings in the Texas oil fields. They are almost the only fossils in the thick series of calcareous clays that overlie the oil sands in the Tampico district, and in this last region alone will eventually contribute more in dollars and cents to the wealth of the world than all of the issues of the Congressional Record that have ever been printed.

Probably the laymen requires no introduction to corals. All boys can probably be divided into two classes, at least such was once the case—those who avowed that they were going to be locomotive engineers when they grew up, and those who longed to explore a coral reef or live on a South Pacific coral atoll. Any one who has never experienced the thrill that comes from contemplating the profusion of surging life in and around a coral reef, or does not know the fascinating beauty of even the dead skeletons of coral life would do well to read the popular illustrated account by Vaughan in the last annual report of the Smithsonian Institution.

Corals are all small marine animals, but many of them dwell in colonies, notably the so-called stone corals, and secrete the calcareous skeletons familiarly known as corals. Like the Bryozoa, corals are sedentary except for the short period when they have a free-swimming larval fling as it were. Their ancestors go back as far as the fossil records go, and they have never suffered the obliquity as horizon markers that has at times attached to the Bryozoa and Foraminifera.

Reef corals require definite temperatures and environmental conditions in order to flourish. hence they are useful in retrospective prophecy. Geologically they are especially important during later geological times in Mediterranean regions—in the south of Europe, the Antilles, and the balance of equatorial America. Their contribution to our understanding of the relations and geological history of the Antilles is probably not equalled and certainly not exceeded by any other group of organisms.

In conclusion to cite but a single pragmatic instance of the ultimate commercial value of these monographic paleontologic studies that are published by the National Museum—the exploration for oil in central and northern South America, and the successful interpretation of structure that is the key to commercial success or failure in the far off *tierra caliente* of Colombia or Venezuela, rests very largely on the application of the results of the unostentatious and unadvertised paleontologic studies.

EDWARD W. BERRY
JOHNS HOPKINS UNIVERSITY

SCIENTIFIC EVENTS

A NEW OBSERVATORY IN CLEVELAND

CASE School of Applied Science, Cleveland, Ohio, dedicated a new observatory on Columbus Day, October 12, 1920. It is to be known

as the Warner and Swazey Observatory, in honor of the donors, members of the noted firm that have made so many of the largest and best telescopes in this country. Mr. Warner is a trustee of Case School of Applied Science, and both men have long taken an active interest in the work of the school. They secured the site on the brow of a hill overlooking a residential section of East Cleveland, about two miles from the campus, but easily accessible, and erected on it a handsome brick structure filled with all the necessary equipment to carry on college instruction in astronomy. The gift to Case is the most noteworthy addition to astronomical equipment in this section of the country, and especially significant because it is in the home city of the men whose name it will bear.

The observatory is L-shaped, with the tower and dome at the angle. One wing contains two astronomical transits, and a zenith telescope, all from the Warner and Swazey factory. The other wing contains a constant-temperature clock room, provided with two Riefler clocks, and a library room, suitable for class use as well, housing the school's collection of astronomical books. The tower will accommodate a small class where the ten-inch telescope is mounted. The lens was ground by John Brashear, of Pittsburgh. The tube is fitted with every device known to the expert makers to increase its usefulness. In the basement are living apartments for a caretaker, a storeroom, a battery room, and a dark room for photographic purposes.

At the dedicatory exercises, which were held outdoors on the grounds, both Mr. Swazey and Mr. Warner spoke, the former relating some of the firm's experiences in the making and improving of astronomical instruments, and the latter referring especially to the instrument presented to Case, and making the formal presentation. President Charles S. Howe accepted the gift on behalf of the trustees. The main address of the occasion was given by Director W. W. Campbell, of the Lick Observatory of the University of California, on the subject, "The Daily Influence of Astronomy." Professor D. T. Wilson, professor of astronomy at Case, outlined the work done at the school in astronomy, and the services he hoped the school would be able to render the community by means of this splendid observatory.

K. O. Thompson

A SURVEY OF FOREST RESEARCH

"North American Forest Research" published as Vol. 1, Part 4, No. 4, of the *Bulletin of the National Research Council,* Washington, D. C., is a summary of the investigative projects in forestry and allied subjects. It covers the work carried on in 1919–1920 by national, state, and provincial governments, schools of forestry, scientific schools and private interests in Canada, Newfoundland and the United States. The work is a compilation by the committee on American forest research, of the society of American Foresters. It is the first and only authoritative and complete outline of research work in forestry devoted to increasing the knowledge of the best means of producing and utilizing one of the greatest natural resources of the North American continent.

Agricultural research, as exemplified by the agricultural experiment stations, has proved its practical value. Forest research attempts to do for forest production what agricultural research has done for agricultural production.

The bulletin describes the investigative work that is being done in four main fields. (1) Utilization of forest products; (2) Proper handling of the forest and its perpetuation; (3) Proper handling of the range within or adjoining forests; (4) Forest economics, or the relation of the forests and their products to the economic life of the continent.

The survey is said to contain brief descriptions of studies being carried on for practically every important forest region, type and tree and in every province and state in which the forests are an important economic factor in North America.

A SCORE FOR HEALTH ACTIVITIES

The New York State Department of Health has prepared an activities score for cities with

a population of from 25,000 to 175,000 inhabitants. Of a possible 1,000 points for perfect, adequate public health nursing service counts 75; other follow-up social service 10; adequate dispensary or clinic service 70; hospital facilities for the communicable diseases 45; a day nursery 10; Little Mothers' League 10; good newspaper publicity regarding health matters 50; and a physician in charge of the infant welfare station 15. This gives a total of 285 points for activities in which the nurse is directly concerned. In general the score provides the following distribution of credit:

Communicable disease control:	
Tuberculosis, perfect score	60
Venereal diseases, perfect score	70
Other communicable diseases, perfect score.	80
Adequate laboratory facilities and use of same	100
Infant and maternal welfare	90
Milk and food inspection	100
Water supply	100
Sewage, garbage and manure disposal	40
Record keeping	85
Public health education	120
An appropriation of at least 50 cents per capita for health protection	100
Effective enforcement of regulations governing barber shops, common towels, drinking and eating utensils	20
Unusually meritorious public health work along either new or old lines	35
Total	1,000

COUNCIL MEETING OF THE ILLINOIS STATE ACADEMY OF SCIENCE

AT the call of President Cowles a meeting of the council was held at the University Club, Chicago, on September 28. There were present President Cowles, retiring President Ward, Vice-president Knipp, Treasurer Watermann and Librarian Crook.

The first question taken up was how best to meet the great misfortune which had befallen the academy in the death of Secretary Pricer. It was voted that the librarian continue until the next meeting to serve as secretary, as he had been doing at the request of the president since the death of Secretary Pricer. With some misgivings as to the wisdom of such appointment the librarian consented.

In conformity with action at the Danville meeting the following legislative committee was appointed: H. C. Cowles, Chicago, chairman; William Barnes, Decatur; E. W. Payne, Springfield; R. M. Barnes, Lacon; Geo. Langford, Joliet.

It was voted that the fiscal year of the academy begin with the calendar year and that dues be payable on the December 1st preceding, to accord with arrangements with the A. A. A. S. The secretary was instructed to mail the three volumes of *Transactions* which are to appear shortly, to paid-up members only.

It was decided to hold the annual meeting for 1921 at Carbondale some time in the spring with the hope of having a field day and the president was requested to begin arrangements for such meeting. The president was requested to appoint chairmen for the various sections which it might seem advisable to form at the coming meeting. The treasurer presented matters concerning various classes of members and the relation between the State Academy and the A. A. A. S. It was suggested that he publish a list of members whose address is unknown, in hope that some member can supply the information wanted.

The following committee was appointed to continue the work of interesting high school science clubs, other science clubs, boards of education, teachers, etc. in the work of the academy and to suggest to them the desirability of sending delegates to academy meetings: Charles T. Knipp, Chairman, Urbana; W. G. Watermann, Evanston; R. H. Linkins, Normal; H. S. Pepoon, Chicago.

A. R. CROOK,
Acting Secretary

THE ENGINEERING FOUNDATION

AN anonymous gift of $200,000 toward a five-million-dollar fund for the promotion of research in science and in engineering is announced by Engineering Foundation at its headquarters in the Engineering Societies Building, New York City. This contribution

brings the foundation's fund to $500,000. It is the aim of the foundation to obtain one million dollars by January first.

Engineering Foundation was organized to care for the gifts aggregating $300,000 of Ambrose Swasey, of Cleveland, Ohio, the income from these gifts being devoted to research. Since its organization as a trust fund in 1914, the funds of the foundation have been used to aid the National Research Council and others in performing research directly connected with engineering. Mr. Swasey's gifts were made to United Engineering Society as a nucleus of a large endowment "for the furtherance of research in science and in engineering, or for the advancement in any other manner of the profession of engineering and the good of mankind."

The Engineering Foundation is administered by the engineering foundation board composed of members from the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, and American Institute of Electrical Engineers and members at large. The board is a department of United Engineering Society. It is the instrumentality of the founder societies named for the stimulation, direction and support of research.

The officers of Engineering Foundation are Charles F. Rand, chairman; Edward Dean Adams, first vice-chairman; Frank B. Jewett, second vice-chairman; Joseph Struthers, treasurer; and Alfred D. Flinn, secretary. The executive committee is composed of Charles F. Rand, chairman; Edward Dean Adams, George B. Pegram, Frank B. Jewett and H. Hobert Porter.

A statement issued by the foundation says:

> Potential benefits for the whole nation are very great, but these benefits can not be gained without expenditure of effort and materials. Research workers must be supported. Equipment, materials, working places and traveling facilities must be provided. Since the benefits accrue to the profession, the industries and the public in general, support in large measure should come from general funds, such as those provided by endowments. Engineering Foundation seeks to build up its endowment to dimensions worthy of the engineering profession. Engineers connected with industrial and financial organizations having great resources can aid by convincing proper officials of corporations that the continued prosperity of our industries depends upon continued progress of research. Since the commercial and industrial establishments of the country reap the larger proportions of the financial profits arising from scientific and technological work, these establishments should contribute liberally to the support of research.
>
> There are many problems relating to the materials and forces of engineering on which further knowledge is needed. Progress will be made approximately in proportion to the funds made available. But there are other kinds of problems which concern the engineer. No longer may one declare, as did Professor J. H. Johnson a generation ago, that "Engineering differs from all other learned professions in this, that its learning has to do only with the inanimate world, the world of dead matter and force."
>
> Many acute social and economic questions of our day need the dispassionate, impartial, patient study of scientists and technologists. To these questions must now be applied the scientific method of collecting facts by thorough study, and the engineer's capacity for planning and performing, instead of ill-considered "reforms."
>
> Occasionally experimental work is undertaken in accordance with a well-conceived plan as a necessary or desirable adjunct to the main operation. In such cases the exigencies of the main operation sooner or later interrupt the experimental work; or the men who have it in hand leave the force; or the information is gained but never written up; or the statement is buried in some report of limited circulation; or greater familiarity with research methods and a broader conception of the problem could, with small additional expense, have secured much more valuable results and have made them more generally useful.
>
> These services and many others could be performed by Engineering Foundation, if adequate funds could be placed at its disposal. The Foundation does not plan to build laboratories and conduct research work directly, but rather to stimulate, coordinate and support research work in existing scientific and industrial laboratories, cooperating, in so far as possible, with the National Research Council.

SCIENTIFIC NOTES AND NEWS

AT the annual meeting of the Royal Society on November 30, Dr. C. S. Sherrington, Wayneflete professor of physiology at the University of Oxford, was elected president to succeed Sir Joseph Thomson.

DR. E. H. GRIFFITHS has been elected general treasurer of the British Association in succession to the late Professor John Perry.

THE Weldon medal has been conferred by the University of Oxford upon Dr. J. Arthur Harris, of the Station for Experimental Evolution of the Carnegie Institution of Washington, in recognition of his work in biometry. The Weldon Medal, accompanied by a monetary prize of about £90 may be awarded every three years ". . . without regard to nationality, sex, or membership of any University, to the person who, in the judgment of the electors, has, in the six years next preceding the date of the award, published the most noteworthy contribution to biometric science," in the field of zoology, botany, anthropology, sociology, psychology or medical science.

THE King of Italy has conferred upon J. E. Zanetti, assistant professor of chemistry in Columbia University, the order of the crown with the rank of officer, for services rendered during the war as lieutenant-colonel in the Chemical Warfare Service. He has also received from the French government the legion of honor and from the British government the distinguished service order.

PROFESSOR ALBERT P. WILLS, of the department of physics in Columbia University, and Dr. Frederick Barry, formerly instructor in chemistry, have been awarded the Ernest Kempton Adams research fellowship by Columbia University. This fellowship was founded in 1905 by Edward Dean Adams in memory of his son Ernest Kempton Adams, E.E. '97, A.M. '98. The provision of the fellowship is that its incumbent "shall prosecute researches either in Columbia University or elsewhere, in the physical sciences, in psychology or in their practical applications."

DEAN P. H. ROLFS, for fifteen years director of the Florida Agricultural Experiment Station and for the past six years dean of the Agricultural College, has been granted leave of absence to locate, establish and conduct an agricultural institution for the state of Minas Geraes, Brazil. His address after January 1 will be at Bello Horizonte, Minas Geraes, Brazil. The president of that state desires to have a full corps of scientific workers appointed from the United States.

IT is stated in *Nature* that the following have been elected officers of the Cambridge Philosophical Society for the session 1920–1921: *President,* Professor Seward; *Vice-presidents,* Sir E. Rutherford, Mr. C. T. R. Wilson and Dr. E. H. Griffiths; *Treasurer,* Professor Hobson; *Secretaries,* Mr. H. H. Brindley, Professor Baker and Mr. F. W. Aston; *New Members of the Council,* Professor Marr, Mr. C. T. Heycock, Mr. H. Lamb, Professor Hopkins, Dr. Bennett and Dr. Hartridge.

FIVE university lectures on "The theory of relativity" are being given at Cornell University by Dr. L. Silberstein, of the research laboratory of the Eastman Company, of Rochester. Dr. Silberstein suggested that a preliminary lecture beginning with the experimental basis of the theory of relativity would be helpful, and such an introductory lecture was given by Professors Floyd K. Richtmyer and E. H. Kennard, of the physics department of the university.

C. E. KENNETH MEES, director of the research laboratories, Eastman Kodak Company, delivered a lecture on December 2, before the Franklin Institute, Philadelphia, on "The structure of photographic images."

ELMER D. MERRILL, director of the Philippine Bureau of Science, delivered on November 18, an address on "Land and nature in the Philippines," before the Washington Academy of Sciences.

PROFESSOR J. STIEGLITZ, of the University of Chicago, gave three lectures on the Mayo Foundation at Rochester, Minnesota, on November 3, 4, and 5, on "Chemistry and

medicine" and "The electric theory of combustion."

Dr. J. Paul Goode, professor of geography in the University of Chicago, gave an address before the general staff of the College of the Army at Washington, D. C., on November 12, on "The geographic and economic foundations of the world war."

Professor Harold Hibbert, of Yale University, lectured before the Stamford Chemical Society on "The constitution of cellulose" on the evening of October 25.

Dr. Frederick H. Getman lectured before the Rhode Island State College on November 18 and before the Rhode Island Section of the American Chemical Society at Providence, on November 19, taking as his subject "The relation between absorption and spectra and chemical constitution."

Baron Gerard DeGeer, professor of geology at the University of Stockholm, delivered two lectures at the University of Michigan on November 12. The topic of the lectures was "An autographic record of climate for the last ten thousands of years," in which lectures the methods of work and the applications to Sweden and America were discussed.

The annual Huxley memorial lecture of the Royal Anthropological Institute was delivered by Dr. A. C. Haddon, in the lecture-room of the Royal Society on November 23, on "Migrations of Cultures in British New Guinea."

A monument has been erected at Castera-Verduzan, Gers, France, to the memory of the celebrated French surgeon and pathologist, Lannelongue, who died in 1911.

We learn from *Nature* that the council of the British Association has agreed to the formation of a separate section of psychology, as recommended by the sections of physiology and educational science at Cardiff, and approved by the general committee. Consideration of the number and scope of the various sections is to be referred to a special committee. It has been decided to invite national Associations for the Advancement of Science to send representatives to annual meetings of the British Association in future.

The second International Congress of Comparative Pathology will be held at Rome in April, 1921. An organizing committee has been established under the presidency of Professor Perroncito, composed of Professors Ascoli, Golgi, Grassi, Lustig, Marchiafava, Paterno, Raffaele, Sanarelli, and Colonel Bertoletti. Among the subjects to be discussed are influenza in man and animals, foot-and-mouth disease, recent researches in sarcoma and carcinoma, rabies and antirabic vaccination, piroplasmosis, acari and scabies in man and animals, and phylloxera.

The Upsilon Sigma Chapter of the Chi Phi medical fraternity has been installed at Columbia University. The installation ceremonies and a dinner of the fraternity were held recently at the Hotel Netherland in New York.

Since October the Dominion Observatory, Ottawa, has been recording on the chronograph the Arlington and Annapolis wireless time signals, together with the Observatory Riefler clock.

The Smithsonian Institution, of which her father, Joseph Henry, was secretary for many years, is to be the ultimate beneficiary of the estate of Caroline Henry, according to the terms of her will, which has been filed for probate. An immediate bequest of $1,000 is made to the institution, together with several other bequests. The net income from the remaining estate is to be distributed among several beneficiaries upon whose death the estate is to go to the Smithsonian Institution.

Nature writes "the council of the British Association has recently had before it the suggestion made by Professor Herdman in his presidential address at Cardiff for a new *Challenger* expedition for the exploration of the great oceans of the globe with modern instruments and methods. It will be remembered that this proposal received the support of all the sections of the association by formal resolution, and the council was asked to appoint

a committee to take the necessary steps to urge its need upon the government and the nation. This committee has now been appointed, and the scientific world will follow its activities and their result with close attention. An oceanographical expedition along the lines contemplated, and equipped with the instruments which modern science can provide, would lead to a great increase of knowledge both for scientific study and for profitable development, and no nation could carry it out more appropriately than Great Britain in cooperation with our overseas Dominions. There will be an eclipse of the sun in September, 1922, with the line of totality crossing the Maldive Islands, and the expedition could very well include an astronomical party to observe it. It is believed that the Admirality is favorably disposed towards the scheme, and every scientific man hopes that the necessary support will be forthcoming to carry out the enterprise on a scale worthy of the British empire."

THE annual meeting of the British Medical Association will be held on July 19, and the scientific sections will meet on July 20, 21 and 22. The annual meeting in 1922 will be held in Glasgow, and the council has now decided to recommend to the Representative Body that the annual meeting in 1923 shall be held at Portsmouth, in response to an invitation of the Portsmouth Division.

THE Rockefeller Foundation announces the gift to the State of Louisiana of the Grand Chenier Wild Life Refuge, comprising about 35,000 acres, in Cameron and Vermillion laboratories, equipment, methods, publications. parishes. The tract was purchased from individual holders by the foundation in 1914, in order to preserve the wild life of the country and has since been under the supervision of the Department of Conservation of the State. A condition of the gift is that the tract shall remain as a perpetual wild-life preserve.

EDUCATIONAL NOTES AND NEWS

THE two weeks' campaign for a $5,000,000 endowment fund for McGill University ended with the collection of $6,321,511.

DR. JOHN GABBERT BOWMAN, president of the University of Iowa from 1911 to 1914 has been elected chancellor of the University of Pittsburgh to succeed Dr. Samuel Black McCormick.

THE Cornell University board of trustees at its meeting on November 13, assigned professors to eight professorships which were established last June commemorating the service of Cornellians in the war. The assignments in science are Professor Ernest Merritt (physics), in arts and sciences; Professors S. S. Garrett and E. W. Schroder, in engineering; Professor W. D. Bancroft (physical chemistry), in the graduate school; Professor Sutherland Simpson (physiology) in the Ithaca division of the medical college.

AMONG recent appointments to the faculty of the college of arts and sciences of Tulane University are the following: Dr. D. S. Elliott, recently head of the department of physics in the Georgia Institute of Technology, has been elected to the professorship of physics. Dr. S. A. Mahood, chemist of the Forest Products Laboratory of the University of Wisconsin, has been elected to an associate professorship in chemistry. Dr. Herbert E. Buchanan, professor of mathematics in the University of Tennessee, has been elected to the chair of mathematics.

MR. J. W. BARTON, recently fellow in psychology in the University of Minnesota and formerly a member of the faculty of the University of Utah, has been elected associate professor of psychology in the school of education of the University of Wyoming.

R. J. GARBER, assistant professor of plant breeding at the University of Minnesota, has been appointed associate professor of agronomy and associate agronomist in the West Virginia University and Station.

DISCUSSION AND CORRESPONDENCE

RECEDENT LAKE SHORES OF THE CRETACEOUS

LAST year while cycad hunting in the southern Black Hills, Mr. E. F. Arnold called my

attention to a remarkable reef of huge concretions in the Lakota of "Driftwood Cañon" several miles northerly through the "rim" from the Burlington dam. The forms simulated huge more or less globular cycads three or four feet through, and displayed much coarse radial structure, with more or less granular siliceous or even sandy, to partly limy texture. As an illustration of these forms, Plate 21 in "Lakes of North America," by I. C. Russell, showing an old lake Lahontan shore, would all but serve. Though knowing the Lakota of the Black Hills so widely, and never having noted anything similar before, I looked on the Driftwood reef as belonging to the domain of the purely inorganic.

Now, however, this phenomenon has come up in a much more tangible form. Early this year Mr. Jesse Simmons, a geologist of the Midwest Refining Company wrote me that he had observed innumerable cycad-like masses in the Lakota [Cloverly] of the Como anticline, about sixteen miles easterly from Medicine Bow, Wyoming. On reaching this point last August I found very striking conditions indeed. There is, fairly speaking, a reef of the calcareous concretionary forms, or tufaceous heads of finely radiate structure. This lies near the top of a sandy to conglomeratic rim 80 or more feet thick resting on the broadly exposed [Como of Marsh] Morrison. The reef stratum itself marks a change in sedimentation, being sandy, to shaly or slightly limy, with the concretions very definitely in the lower portion and varying from quite globular types one to two feet in diameter up to much larger more irregular shaped masses. While immediately within the reef occur numerous smoothed quartz pebbles from small up to several pounds weight. Of these many are simply smoothed or with a ground-glass surface, but many others are polished, and of the type known as "Dreikanter" with the desert "patina." Such are like, though in no way to be confused with the *gastroliths* of the Como or other Dinosaurians.

As showing in a most curious manner the course of events on this reef one of the concretions, a subspherical example one and one half feet through which I packed and sent back to Yale, contains imbedded well toward its center one of the highly smoothed pebbles a half pound in weight. All round this pebble the radiate concretionary structure runs as uninterruptedly, the same as if no pebble were present. Evidently when these siliceous pebbles containing traces of fossils of some earlier geologic period were being smoothed by wind or wave or both, and when the masses of calcareous tufa were being deposited from more or less saturated waters, a wave cast that pebble on top of the first formed basal or squamous rosette. Then the tufaceous mass, with little increase of diameter, continued its growth and regularity of structure upward as before.

Of such tufa reefs as these, and such pebbly shore lines of the western Cretaceous, little is as yet known, and to my knowledge nothing has been reported hitherto. But inasmuch as the general facts seem to indicate conditions not unlike those found about such recedent lakes as Bonneville and Lahontan, it is hoped this preliminary note may call forth much further observation afield. If those who have perchance seen the tufa reefs, and especially the smoothed pebble beaches, would kindly report their observations I would esteem it a favor. It is not improbable that some considerable and synchronous lacustrine shore lines can be definitely located, a result which would be of the first geologic interest.

To what extent algal life has played a part in the growth of these tufas of more remote geologic time is not fully understood. In the case of all the finely radiate tufas there is less likelihood of substitution of any kind than in the coarser Thinolitic type of Lake Lahontan studied by E. S. Dana. It seems unlikely that the masses often of such striking regularity of form could result from purely inorganic processes.

G. R. Wieland

Yale University

Is Honey a Luxury?

In the October 15, 1920, number of Science appeared an article by Mr. J. J. Willaman,

headed "Levulose Sirup," which contained one statement that I believe should be corrected. He states that of the four sugar products, glucose, sorghum, honey and maltose, "sorghum and honey are the only ones that compete with sugar in sweetness," and farther on in the article adds "of the two sweeter products, honey will probably of necessity always remain a luxury." It is this last statement to which I take exception.

Honey should not be considered a luxury. It is the form of sweet that was used long before cane sugar was ever thought of, and is in many places now a staple article of food. During the sugar shortage caused by the late war honey was used to a much greater extent than ever before in this country and thousands of families used honey almost exclusively in place of sugar. In addition, millions of pounds were exported. One reason that honey is often considered a luxury is because it is too frequently bought in such small quantities that the purchaser is paying far more for the container and the labor of putting the honey up in such form than he is for the honey itself. The writer knows a number of families who buy extracted honey regularly in 60 pound lots and consider it a staple article of food rather than a luxury.

Enormous quantities of honey are used in baking in this country, both for home baking and by commercial baking firms, since honey possesses a number of advantages over sugar in baking. It is stated that the National Biscuit Company at one time bought seventy carloads of honey in one lot. Honey is also extensively used in the making of fine candies, high-grade ice cream and soft drinks.

It is a commendable thing to point out as Mr. Willaman has done, how a new industry may be developed, especially when the product of such industry is to be a food, yet it is unjust in pointing out such a possibility to make a statement which tends to foster a mistaken idea, entirely too prevalent already, about another food product, an idea that the beekeeping industry and all its sponsors are trying to eradicate. The beekeeping industry in this country is annually conserving millions upon millions of pounds of one of the finest food products existent that would otherwise be absolutely lost. Yet many times the amount saved is actually lost because this industry is not developed to such an extent as to take care of more than a small percentage of the possibilities. The complete development of this industry can come only when the people as a whole recognize honey as a staple article of food rather than as a luxury.

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THE FLIGHT OF FIREFLIES AND THE FLASHING IMPULSE

FIREFLIES are wonderfully interesting creatures. There is something marvellous in the physiology of a lowly living mechanism that can transform chemical energy into luminous energy with such a nearly perfect radiant efficiency and with so little effort as do the fireflies. Theirs is a light without appreciable heating effects, because in some manner the energy of special chemical reactions taking place within their tissues, is transformed almost entirely into luminous energy.

If one observes fireflies[1] closely it will be noted that their flight movements and flashing under certain conditions bear some relation to each other. During the day these insects seek concealment in the low herbage and grass. With the approach of evening they become active and just after sundown may be seen to arise in great numbers from the damp herbage, flashing leisurely from time to time. If the air is still and warm, it will be noted that as the creatures arise very slowly, each flash is attended by a sudden upward flight impulse which may even carry them almost straight upward several feet. Usually, however, they are propelled upward in a more or less curved path.

At this time the flight of the fireflies appears to be very weak, for they drift along aimlessly, and appear almost unable to keep clear of the herbage, often actually descending

[1] These observations apply to the behavior of the species *Photinus pyralis* Linn.

as if to alight again. When it seems that they must inevitably terminate their flight and settle down upon the herbage, another flash renews and quickens the flight impulse and they arise precipitately, as if suddenly propelled upward by some energizing stimulus attending the flash.

This striking behavior may be observed almost any calm evening throughout the summer. It is particularly noticeable when the insects are arising from the herbage, and are just preparing to get fairly on the wing. What is the actual significance of this luminosity to the insects? In what manner does the flash stimulate momentarily the powers of upward flight? It would sometimes seem as if the energy-transformation attending the flash, actually aided them to get fairly on the wing, possibly also sustaining their flight in some manner.

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SPECIAL ARTICLES

FUNGICIDAL DUSTS FOR CONTROL OF SMUT

For more than a century efforts have been made to secure a perfect method of treating cereal seeds to destroy smut spores carried on their surfaces. Many fungicides have been tested and a number of standard formulas have been put forth as efficient. More recent investigations have demonstrated that none of the formulas involving dipping seed in solutions, fumigating with powerful gases or dissolving spores by various solvents, has proven completely successful. Reagents of sufficient strength to destroy the smut spores have proven to be injurious to the germination of the seed.

It has been demonstrated recently by the writers and by many other investigators, that the commonly accepted standard smut fungical formulas involving the use of bluestone and of formaldehyde, are frequently extremely injurious to the germination of the seed and the development of the seedlings. In arid and semi-arid wheat areas, formaldehyde frequently causes serious losses in seed planted in dry soil. Bluestone, the preferred fungicide in such regions, causes serious losses in germination and delayed growth of seedlings. Threshing operations in semi-arid regions cause greater rupture to seed coats than occur in more humid regions, further increasing seed injury. To avoid these losses, it has been recommended that the bluestoned seed be dipped, after a short drain, in a lime solution to react with the copper and thus check the penetration of the copper sulphate in the seed germ as soon as it has destroyed the bunt spores adhering to the surface of seed. Unless the seed coats have been badly ruptured this formula is very effective but it has been found that the seed does not pass so freely through the drill and, in cold damp weather, the seed dries slowly due to the coating of lime and hence may cause fermentation or heating. To avoid these troubles experiments with bluestone used as a dust were undertaken. The partial success of flowers of sulphur in preventing bunt in California and the reported success with copper carbonate by the Department of Agriculture of New South Wales, gave encouragement for attempting dust treatments.

Little Club wheat dusted with spores of bunt (*Tilletia tritici*) at the rate of 1 part of spores to 750 parts of seed by weight and treated according to standard formulas, gave the following results:

Fungicide	Treatment		Smutted Plants %	Smutted Heads %
	Strength	Germination %		
Check	—	99.0	12.8	6.2
Formaldehyde	1-40	98.0	0.	0.
Copper sulphate	1-4	12.5	0.	0.
Copper sulphate + lime solution	1-4 1-8	80.0	1.7	.4
Copper carbonate	dust	95.3	0.	0.
Copper sulphate	dust	54.1	0.	0.
Copper sulphate dust mixed with calcium carbonate dust (1-1)	dust	98.3	0.	0.
Copper sulphate and lime dusted separately	dust	96.5	0.	0.

Rod row plantings were made March 8, 1920, and later, which accounts for the rather

light smut attack. The seed was harvester thrashed and showed considerable injury to the seed coats permitting maximum bluestone injury. The tests were replicated from 2 to 9 times and the average tabulated.

The results compiled from repeated tests demonstrate the effectiveness of copper sulphate dust when mixed with equal parts of calcium carbonate dust in the control of bunt attack due to seed-borne spores. No damage to seed germination occurred. Copper carbonate dust was equally effective. These dusts, especially the copper sulphate adhered tightly and completely covered all parts of the seed wheat. The process of shaking the wheat in dusting removed a large portion of the bunt spores. Two ounces of the dusts per bushel are considered ample. Copper sulphate and lime are available everywhere at low cost. Further experimentation in representative areas in the wheat belt of the United States is desirable before the dust methods are put into practise among farmers.

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THE AMERICAN ASTRONOMICAL SOCIETY

THE twenty-fourth meeting of the society was held on September 1 to 4, 1920, at Smith College, Northampton and Mt. Holyoke College, South Hadley, Massachusetts. The members lived at the Gillett House, one of the residence halls at Northampton. This was the first occasion on which the society had met regularly at a woman's college, and it was a double pleasure to visit two such institutions, and especially to find in what flourishing condition are their observatories and astronomical departments.

There were five sessions for papers at Smith, and two at Mt. Holyoke, where the society went on the second day. A special feature of the meeting was the conversazione at which various exhibits were shown, including the latest work of the 100-inch telescope at Mt. Wilson.

Sir F. W. Dyson, Astronomer Royal, Greenwich, was elected as an honorary member of the society.

The officers for the ensuing year are:

President—Frank Schlesinger.

Vice-presidents—Walter S. Adams, Otto Klotz.

Secretary—Joel Stebbins.

Treasurer—Benjamin Boss.

Councilors—S. I. Bailey, W. J. Hussey, H. N. Russell, V. M. Slipher, Caroline E. Furness and John A. Miller.

The representatives of the society on the National Research Council will hereafter be elected in the same manner as the officers of the society. The present members on the Division of Physical Sciences are: W. W. Campbell, H. N. Russell and Joel Stebbins; and these three together with the president of the society, Frank Schlesinger, and W. S. Eichelberger form the executive committee of the American Section of the International Astronomical Union. The committee will organize the American preparation for the triennial meeting of the union in 1922.

About seventy members of the society were in attendance at the meeting, and fifteen new members were elected. The list of papers, abstracts of which are printed in *Popular Astronomy*, was as follows:

The spectra of some variable stars: W. S. ADAMS and A. H. JOY.

Note on the spectrum of T Pyxidis: W. S. ADAMS and A. H. JOY.

Personality in the estimation of tenths: SEBASTIAN ALBRECHT.

Observations of variable stars at the McCormick Observatory: HAROLD L. ALDEN.

Parallax determinations of bright stars: HAROLD L. ALDEN and S. A. MITCHELL.

Variable stars in Messier 22: S. I. BAILEY.

Concerning results of observed gravitational light deflections: LOUIS A. BAUER.

Ghosts and oculars: LOUIS BELL.

On telegraphing the position of a celestial object: ERNEST CLARE BOWER.

Notes on the classification of long period variables: LEON CAMPBELL.

Notes on changes in the spectrum of η Carinæ: Annie J. Cannon.

A probable factor in the widening and increase in wave-lengths of the spectrum lines near the limb of the sun: Ralph E. DeLury.

The constancy of the solar wave-lengths and the possibility of determining the solar distance therefrom: Ralph E. DeLury and H. R. Kingston.

Notes on the solar rotation: Ralph E. DeLury and John L. O'Connor.

Map of Mars in 1920 and method of producing it from drawings: A. E. Douglass.

A photometric study of Y Camelopardalis: R. S. Dugan.

The photometric fields of three Yerkes telescopes: Alice H. Farnsworth.

Circulation of calcium flocculia about sun-spots: Philip Fox.

Note on Nova Cygni No. 3: Edwin B. Frost.

Some recent photographs taken with the 100-inch Hooker telescope: George E. Hale.

The Mount Wilson photographic map of the sun-spot spectrum: George E. Hale and Ferdinand Ellerman.

The orbit of the spectroscopic binary H. R. 6385: W. E. Harper.

The light-curve of Eros in 1914: A correction to the results previously published: Margaret Harwood.

A curious effect of superposition of two photographic plates: F. Henroteau.

A graphical construction for obtaining the period of a phenomenon: F. Henroteau.

Nova Cygni No. 3. Preliminary results: F. Henroteau *and* J. P. Henderson.

The spectroscopic binary ν Eridani: F. Henroteau and J. P. Henderson.

New lines in the spectrum of oxygen: C. C. Kiess.

Velocity-curves for spectroscopic binaries: Edward S. King.

Photometry of eclipsed moon: Edward S. King.

The eclipsing binaries μ^1 Scorpii and V Puppis: Antonia C. Maury.

Parallax results obtained at the Yerkes Observatory: Oliver J. Lee and George van Biesbroeck.

Photographic zenith tube at the U. S. Naval Observatory, 1915.9–1920.0: F. B. Littell.

The systematic errors of stellar parallaxes determined by photography at the Leander McCormick Observatory: S. A. Mitchell.

Absorption of the photographic rays by the atmospheric water content: George Henry Peters.

The spectroscopic orbits and absolute dimensions of the eclipsing variables TX Herculis and Y Cygni: J. S. Plaskett.

When an eclipse prevented a war: William F. Rigge.

Direct micrometrical observations of the sun. Exact formulas: E. D. Roe, Jr.

The mensurational properties of the photographic plate: Frank E. Ross.

A solution of R minus D observations: Arthur J. Roy.

The radial velocities of ten Oe5 stars: W. Carl Rufus.

On the probable diameters of the stars: Henry Norris Russell.

Radiation pressure and celestial motions: Henry Norris Russell.

The astronomical aspects of æther theory versus relativity: L. Silberstein.

Progress in photo-electric photometry, with a new light-curve of Algol: Joel Stebbins.

The investigation of plate errors in photographic photography: Harlan True Stetson.

Arlington time signals: R. Meldrum Stewart.

Temperature compensation of chronometers: R. Meldrum Stewart.

Canadian transcontinental longitudes: R. Meldrum Stewart.

Notes on the variables 9.1914 and RT Vulpeculæ: S. D. Townley.

A new method of observing the position of the centre of the sun: R. W. Willson.

The orbits of Carinæ, Doradus, and Sagittarii: Ralph E. Wilson and C. M. Huffer.

The orbit of the spectroscopic binary H. R. 8800: Reynold K. Young.

The stationary calcium lines in early type stars: Reynold K. Young.

Joel Stebbins,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter